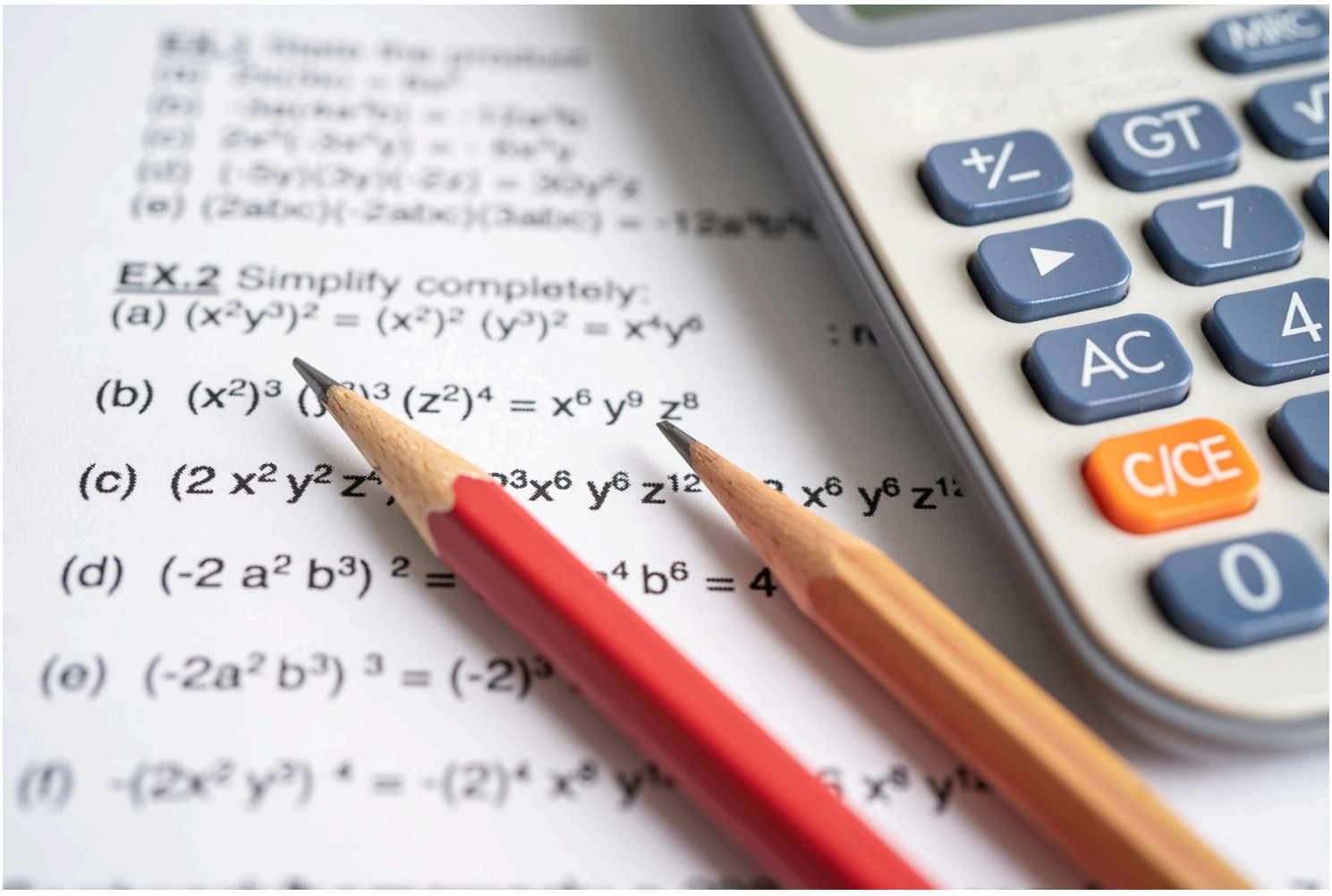
Accommodations Toolkit

Calculator: Research

This fact sheet on **calculators** is part of the *Accommodations Toolkit* published by the National Center on Educational Outcomes (NCEO). It summarizes information and research findings on the use of calculators as an accommodation. This toolkit also contains a summary of states' accessibility policies for calculators (/nceo/accommodations-toolkit/calculator-policies).


EX.2 Simplify completely:
(a) $(x^2y^3)^2 = (x^2)^2 (y^3)^2 = x^4y^6$
(b) $(x^2)^3$ ... $(z^2)^4 = x^6 y^9 z^8$
(c) $(2 x^2 y^2 z^4$ ... $x^6 y^6 z^{12}$
(d) $(-2 a^2 b^3)^2$ = ... $b^6 = 4$
(e) $(-2a^2 b^3)^3 = (-2)^3$ ...
(f) $-(2x^2 y^3)^4 = -(2)^4 x^8$ ...
+/-
GT
7
4
AC
C/CE
0

What is the calculator accommodation? The calculator accommodation involves the use of a small handheld or electronic device to make mathematical calculations. Calculators generally have a keyboard and a visual display. Calculators may be of different types, including graphing, scientific, and four-function calculators (Bouck, 2010; Yakubova & Bouck, 2014). Voice input speech output (VISO) calculators are used by some students with visual impairments (Bouck et al., 2011).

What are the research findings on who should use this accommodation? Calculator use may be beneficial for many students with disabilities, including those with learning disabilities, emotional disabilities, and sensory or physical disabilities (Bolt & Ysseldyke, 2008; Bouck & Long, 2021). Students with mild intellectual disabilities may also find them useful (Bouck & Long, 2021; Yakubova & Bouck, 2014).

What are the research findings on the implementation of calculator use? Twenty-three studies examined calculator use as an accommodation.

- Fifteen studies looked at the effect of calculator use on performance. The findings were mixed, though most found calculator use to be beneficial.
    - Twelve studies found that students with disabilities performed better on mathematics assessments when they had access to, and used, a calculator (Anjorin, 2009; Bone & Bouck, 2018; Bouck, 2009; Bouk & Bouck, 2008; Bouck & Yadav, 2008; Bouck et al., 2015; Fuchs, 2000; Fuchs et al., 2000; Randall et al., 2011; Russell, 2014; Taylor, 2017; Yakubova & Bouck, 2014). For example, one study had students with disabilities attempt math problems with and without a calculator. The result was higher scores on average when the calculator was used (Bone & Bouck, 2018). Another example is a study that examined the use of scientific and graphing calculators by fifth-grade students with mild intellectual disabilities. The study found that both types of calculators increased the accuracy and efficiency of computation and word problem-solving when responding to mathematics questions (Yakubova & Bouck, 2014).
    - Two studies had mixed results. Scarpatti and colleagues (2011) found calculator use was effective for items requiring basic arithmetic but did not benefit students with disabilities who used calculators on difficult items requiring abstract thinking. Engelhard and colleagues (2011) also found that calculator use had mixed results, with increased math scores for students with disabilities in third and fourth grades, but decreased scores for students with disabilities in sixth and seventh grades.
    - Parks (2009) found that calculator use did not increase problem-solving scores for students with learning disabilities and attention deficit-hyperactivity disorder (ADHD).
- A comparison study between eighth-grade students with disabilities and those without disabilities found that calculator use did not benefit students with disabilities more than students without a disability. The findings were similar for both graphing and four-function calculators (Bouck, 2010).
- One study found that high school students with visual impairments completed assessments more quickly when they used a voice input speech output (VISO) calculator than when they did not use it (Bouck, et al., 2011).
- Six studies examined the frequency of use of the calculator accommodation.
    - Three studies found that calculator use was the most common equipment/technology accommodation provided to students with disabilities (Bouck & Long, 2021; Ganguly, 2010; Ysseldyke et al., 2001).

    - One study of eighth-grade students with sensory, physical, and emotional disabilities found that calculators were the most frequently used accommodation on mathematics assessments (Bolt & Ysseldyke, 2008).
    - Another study found that calculator use was one of the most common accommodations allowed on portions of mathematics exams that were not directly focused on a student's ability to do calculations by hand (Finch & Finch, 2013).
    - A comparison of accommodations used for instruction and assessment found that calculators were more commonly used in the classroom than when taking state assessments (Kern, et al., 2019).
    - One study found students with high-incidence disability categories of speech and language impairment and students with learning disabilities had a low rate of reported use of calculator compared to low-incidence disability categories such as deaf-blind (Bouck & Long, 2021).
- Anjorin (2009) found that students may not always know how to use the calculator that they are expected to use during an assessment. Some students with learning disabilities needed assistance manipulating and using the calculator.

What perceptions do students and teachers have about calculator use? Four research studies examined student and teacher perceptions of calculator use as an assessment accommodation.

- Hawpe (2013) examined the perceptions of general and special education secondary teachers regarding the use of the calculator accommodation. Special education teachers were more likely to provide the calculator accommodation than general education teachers.
- Three studies looked at student perceptions of calculator use as an assessment accommodation. There were mixed finding regarding whether students believed the calculator accommodation was helpful. One study found that eighth-grade students who received special education services for mathematics believed that a calculator helped them solve problems correctly (Bone & Bouck, 2018). In another study, students with visual impairments reported positive perceptions of the VISO calculator accommodation. They believed that the VISO calculator provided more independence (Bouck et al., 2011). However, one study found that students with learning disabilities and ADHD reported higher anxiety than typical peers when given the calculator accommodation (Parks, 2009).

What have we learned overall? Calculator use is one of the most common accommodations given to students with disabilities. Overall, the performance of students with disabilities across all grade levels increased when a calculator was used regardless of the type of calculator (e.g., four-function, graphing, etc.) used. Students with visual impairments experienced greater efficiency in solving problems when they used a VISO calculator. Both students and teachers generally perceived calculators to be helpful, though some students may find it stressful if they do not know how to use a calculator that they are given to use during an assessment. It is important to get input on student perceptions regarding this use of the calculator accommodation so that student needs and concerns can be addressed since research found that students with some high-incidence disabilities (e.g., speech language impairments, learning disabilities) may sometimes choose not to use this accommodation.

In spite of numerous studies on the calculator accommodation, additional research is still needed to learn more about some aspects of this accommodation. No studies were identified that examined the use of calculators that are embedded in a test platform. There is a particular need for research in this area since many assessments are now technology-based and provide embedded calculators. Similarly, studies that compare the efficacy of embedded calculators and handheld calculators are needed. Research is also needed that examines whether students are sufficiently familiar with the calculators they are expected to use when taking assessments, and the potential effect on their emotional state and performance if they are not.

Footnotes

[1]

Research on calculators summarized here is also available in NCEO's searchable *Accommodations for Students with Disabilities Bibliography* (https://nceo.info/Resources/bibliographies):/nceo.info/Resources/bibliographies (https://nceo.info/Resources/bibliographies)) and in NCEO syntheses of research (see summaries for: 1999-2001 (https://nceo.umn.edu/docs/OnlinePubs/TechReport34.pdf), 2002-2004 (https://nceo.umn.edu/docs/OnlinePubs/Tech45/Technical45.pdf), 2005-2006 (https://nceo.umn.edu/docs/OnlinePubs/Tech47/TechReport47.pdf), 2007-2008 (https://nceo.umn.edu/docs/OnlinePubs/Tech56/TechnicalReport56.pdf), 2009-2010 (https://nceo.umn.edu/docs/OnlinePubs/Tech65/TechnicalReport65.pdf), 2011-2012 (https://nceo.umn.edu/docs/OnlinePubs/Synthesis94/Synthesis94.pdf), 2013-2014 (https://nceo.umn.edu/docs/OnlinePubs/Report402/NCEOReport402.pdf), 2015-2016 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport412.pdf), 2017 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport423.pdf), 2018 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport423.pdf), 2019 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport433.pdf), 2020 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport436.pdf), 2021 (https://nceo.umn.edu/docs/OnlinePubs/NCEOReport438.pdf). See the reports and online bibliography for additional information about the criteria used to identify studies included in this fact sheet.

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